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ON THE PARASITISM OF CARBONIFEROUS CRINOIDS *

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The nature of the evidences of parasitism in geological epochs will doubtless be of interest to all parasitologists. No statement concerning parasitic conditions among fossil animals is made in any of the usual text-books of paleontology, and the general reference works of zoology make no mention of the matter. Abel (1912), however, in his excellent work devotes two paragraphs to a review of possible conditions of parasitism among fossil animals, calling attention especially to the work of von Graff on the swollen stems of Carboniferous crinoids of Germany. Stromer von Reichenbach (1909) refers to parasitism among fossil corals, and figures a cross section of *Pleurodictyum problematicum* from the Lower Devonian of Eifel. This is regarded by Abel as an example of symbiosis. It seems quite probable that Abel is correct in his interpretation.

Robert Etheridge (1880) was the student who first recognized the nature of the swollen stems of fossil crinoids, though he was unable to determine the nature of the parasite. This was later accomplished by L. von Graff (1885), who was able to determine the nature of the parasite, having discovered the carbonized remains of one of the myzostomids which he regarded as the infecting form. Graff reviewed the literature and referred to numerous species of crinoids which showed swollen stems, some of the species having been based on these swollen stems, which were mistaken for calyces. Graff compared very carefully his results with the swollen crinoid stems as described for recent forms in the Challenger reports, where the infecting forms were known to be myzostomids.

John M. Clarke (1908) has written an excellent paper on the pre-carboniferous evidences of communism and commensalism, calling his study "The Beginnings of Dependent Life." In his extensive collections he has found no trace of definite parasitism, but certainly the cases described by him may be regarded as the beginnings of parasitism. It seems probable at present that true parasitism did not begin until the Carboniferous Period.

Swollen stems of crinoids have often been seen by paleontologists both in America and in Europe, but few have recognized their para-

* An abstract of this paper was published in the Proceedings of the American Society of Zoologists, Dec. 27, 1917, p. 34.

sitic nature. A few species and genera of fossil crinoids have been based on the enlarged stems, the specimens being regarded as aberrant calyces.

The specimens of crinoid stems at the writer's disposal are the first to be recognized in America as many ways suggesting parasitism. Specimens are fairly common in collections of fossil invertebrates, and especially so from the Keokuk beds, where the swollen stems often assume a geoditic nature, which, owing to complete mineralization, destroys the anatomical details and leaves only the outward form.

There is nothing to be added to what is already known concerning the parasitism of Carboniferous crinoids, save that this is the first record made of swollen crinoid stems in America. They have frequently been seen, but so far as I can determine, their nature has never been recognized. There is so little difference between the American specimens and those described by von Graff and Etheridge that a very brief description will suffice.

The specimens vary from a half inch to four inches in maximum diameter, the plates of the stems being enlarged and spread apart. The columnars are often spread out to four or five times their normal diameter, the space between the series of columnars being widened to several millimeters. The individual plates are not separated. The enlargements are often mere bulgings in the stem, and again they take the appearance of large tumors, tapering at each end to join the stem. It is impossible in the present case to determine the location of the parasite, but Graff found the parasite located near the point of greatest enlargement of the stem. The swelling of the stem usually does not distort its pentagonal symmetry.

It should be noted here that Bassler (1908) has described objects of a similar nature, and has interpreted them as due to the geodization of the fragment of stem. The objects I have studied are, however, entirely different from the specimens studied by Bassler, judging from his figures and descriptions. There can be no doubt that many enlarged crinoid stems do not represent parasitism, but are the result of the formation of the geode. Many of them, however, may represent parasitism, and paleontologists have not, to date, taken this fact seriously into consideration.

The writer's interest in these objects is due to the fact that the swollen stems must be regarded as the first evidences of disease in geological history. So far as known no fossil animals suffered from disease prior to the Carboniferous, and these tumor-like masses in the stems of crinoids must be regarded as the earliest evidences of pathological processes. Diseased conditions became more and more apparent from the Carboniferous Period down to the present and disease is more prevalent today than ever before in the history of the world.

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REVIEW AND NOTES

INFECTION AND RESISTANCE. Hans Zinnser, M.D. With a chapter on Colloids and Colloidal Reactions by Prof. Stewart W. Young. Second edition, revised. The Macmillan Company, 1918. xiii + 585 pages. \$4.25.

The second edition of this admirable and scholarly work was prepared, as the author says, under difficult conditions—far from the facilities of libraries and files of reprints. Nevertheless, the changes represent fairly the advances in the field of knowledge since the first edition was completed.

To the chapter on anaphylaxis has been added a wealth of new material. The section on infection and immunity in poliomyelitis is entirely new, as also an extended discussion of immunity in syphilis. A whole chapter has been added on serum enzymes, leukocytic enzymes, on the physical factors which enter into serum reactions, and on colloidal gold reaction. The book has appealed, and will continue to appeal, to those who are looking for insight into the fundamental principles on which rests our knowledge of infectious diseases. Every student of medicine should know and use this work in preparation for the handling of cases in clinic or laboratory.

NOTES

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